THE

MATHEMATICAL THEORY

OF

A NEW RELATIVITY

CHAPTER XIV

THE ROTATIONAL MECHANICS

By

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India.
1936.

Reprinted from the Proceedings of the National Academy of Sciences, India
Vol. 6, Part 3

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Received August 10, 1936.

CHAPTER XIV

The Rotational Mechanics

Introduction

1. There can be two, and only two conceivable explanations of the transmission of light energy through space—first a corpuscular conception that swarms of material particles travel with a high velocity and second, an aether conception that an all-prevading medium vibrates and transmits its undulations with the velocity due to its elasticity.

2. (i) Newton's corpuscular theory broke down because it failed to explain the phenomena of interference, diffraction and polarisation.

(ii) Huygen's wave theory presupposed the existence of an aether and fails to explain many phenomena like photo-electric and Compton effects. There are two fatal objections to it, (a) the waves must scatter away at long distances, and yet short waves continue to possess a quantity of energy independent of the intensity ; (b) as pointed out by Poincaire in his Electricite et Optique an impossible result follows from treating electro-static forces as a medium of tension in the direction of the electric field and pressure at right angles to it, namely, when the medium is in equilibrium the displacement due to elasticity should be infinite, a reductio ad absurdum.

(iii) The modern conception of denying the existence of both matter and medium is an impossible one. Without matter or medium, the propagation of waves is utterly meaningless. We may evade the question by saying that we can actually observe only one effect at a time, but a scientific theory should enable us to comprehend the actual process even though we do not make any

observation at all. The Wave Mechanics certainly gives good results, but fails to give any explanation how light can have both a particle and a wave effect simultaneously. Nature exists without the observation of man, and the human mind ought to be able to comprehend the nature of light, whether actually observed or not. It is the great claim of Quantum Mechanics that it deals with observables only i.e. different states of a body. But the aim of Science should be not only to see a body in two different and independent states, but also to comprehend how the body passes from one state to the other. A moving system may have a specific stable position, and no intermediate stable position; but it must necessarily pass through all the intermediate positions. Any theory which cannot present the various stages through which the system must pass, when undisturbed by observation, but merely postulates that Nature acts by jumps and is discontinuous, must remain unsatisfying. It may be that we observe only the statical effect of a swarm of discreet units and do not follow the track of isolated discreet units. But we must be able to understand how each discreet unit progresses before the theory can be said to represent reality. The modern theory involves self-contradictions like infinite waves suddenly converging to a point and not scattering away, or a single indivisible photon passing through two holes and interferring with itself. There are two fatal objections to it: (a) howsoever much we may console ourselves by saying that the imaginary waves are waves of probabilities or mere waves of partial knowledge or ignorance, we must in our heart of hearts know that what we say is utterly meaningless, if neither matter nor medium exists, (b) in order to express the interaction of n electrons, the wave equation has to represent an imaginary wave propagation in a space of $3n$ dimensions, where n may be a million or more.

3. Both the the wave and the particle aspects can be made intelligible if to the corpuscular character of light a periodic transverse motion of the swarm could be added. Such a theory was published by me in 1933, and is now presented in a mathematical form; but *it is not claimed that in its early stages the theory is either perfect or comprehensive.* At present, it mainly indicates a new line of advance, promising to get us out of the *impasse.*

The essence of it is that the existence of discreet units is the reality, and the conception of waves is a misinterpretation of Nature, being nothing but a mere mathematical effect. Although a swarm of discreet particles cannot ordinarily interfere with one another, a beam of such particles can

produce a wave-effect, if either (i) each particle is a binary system with its components revolving round each other;

or (ii) if the particles, though single units, are emitted from a rotating source.

Section I

THE ROTATIONAL THEORY OF LIGHT

Before dealing with rotational motions mathematically, it would be convenient to state the fundamental basis of the Theory. Newton believed that light consists of material corpuscles, which are herein called "radions". There is only one slight addition made to this conception, which, it is submitted, is simple and natural.

THE SOLITARY ASSUMPTION.

EACH LIGHT CORPUSCLE OR RADION IS INTERNALLY A BINARY SYSTEM, CONSISTING OF TWO COMPONENTS OF EQUAL AND OPPOSITE CHARGES ROTATING ROUND EACH OTHER.

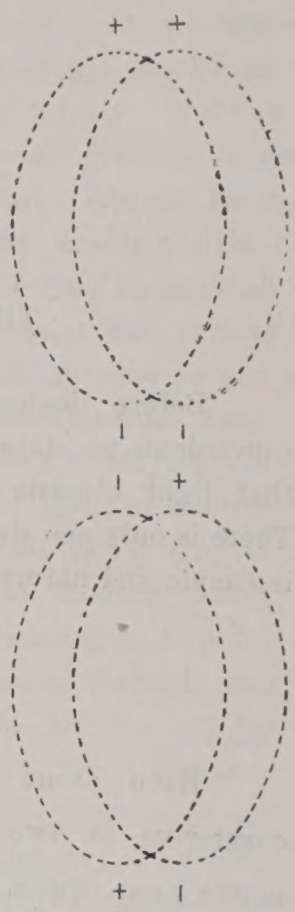
NECESSARY DEDUCTIONS

1. Such an electromagnetic system is a stable system which must propagate itself forward with the velocity of light, the plane of its orbit always remaining parallel to itself.

2. *Although each radion, when emitted from a source travels in a straight line, a swarm of radions successively emitted from the source rotating in its orbit, when seen along a particular direction, is effectively equivalent to a stream of radions travelling outwards with a spiral motion along a screw or helix round an elliptical cylinder corresponding to the orbit, and with the same period of rotation.*

Section II

INTERFRENCE OF BINARY RADIONS.



1. As a light radion consists of two components almost close together with extremely small masses but equal and opposite charges, it will rotate round the common centre of gravity and possess great stability. If two such systems have nearly the same phase, the positive and negative charges will respectively strengthen each other and the intensity of light would be increased. But if there be a difference of π between their phases, the effect will be almost nullified, causing interference. Hence if half of a beam of monochromatic light were to lag behind the other half by an odd multiple of that phase difference, there will be a complete interference. Thus the serious difficulty in comprehending how corpuscles can destroy each other is overcome by the composite character of each.

2. For a circular orbit if the disturbance caused by the positive component the *poson* be represented by

$$\eta = a\ Sin\ (wt + \alpha)$$

then that due to the negative component the *negon* will be

$$\eta' = -a\ Sin\ (\pi + wt + \alpha)$$
$$= a\ Sin\ (wt + \alpha)$$

Thus they together contribute to the total effect, half and half.

The fact is that looked at from the centre there are charges of opposite signs moving in opposite directions at the ends of a diameter, and the field produced by them will be similar to that of two diapoles at right angles to each other. When the masses are equal, the orbit is circular.

Section III

THE SPIN OF RADIONS.

In the general case the two components of a radion i.e. negon poson and with equal and opposite charges and unequal masses will rotate periodically in an ellipse round the common centre of gravity, which will be moving parallel to the Z-axis with velocity c,

The equations of motions of each component can be expressed as

$$x = A + A'. \; Sin \frac{2\pi}{\lambda} (ct + \varkappa)$$

$$y = B + B'. \; Sin \frac{2\pi}{\lambda} (ct + \beta)$$

$$z = C + ct + C'. Sin \frac{2\pi}{\lambda} (ct + \gamma),$$

where A, B, C are constants depending on the position of the centre, A′, B′, C′, are constants depending on the dimensions of the orbit and the inclinations of the plane of the orbit to the planes of reference; and $\varkappa, \beta, \gamma$ are constants depending on the phase differences; and λ represents the wave length of the rotational motion, t denotes absolute time, and c is the velocity of propagation parallel to Z.

Section IV

THE DERIVATION OF MAXWELL'S EQUATIONS.

When a light radion consists of rotating positive and negative charges, the electromagnetic effect of the combined binary system becomes obvious.

(1) As an assemblage of binary radions must contain only pairs of posons and negons, a volume of radions would have zero electric density. Hence Div. $E = 0$.

(2) But the magnetic force is merely the transverse effect of a moving charge, and is therefore round a completely closed curve. Accordingly no isolated magnetic pole can exist in nature. Hence Div . $H = 0$.

Maxwell's equations of motion accordingly follow as a matter of course.

The wellknown relations are

$$\text{Curl } E = -\frac{\mu}{c} \frac{\partial H}{\partial t} \quad \text{and} \quad \text{Curl } H = \frac{k}{c} \frac{\partial E}{\partial t}$$

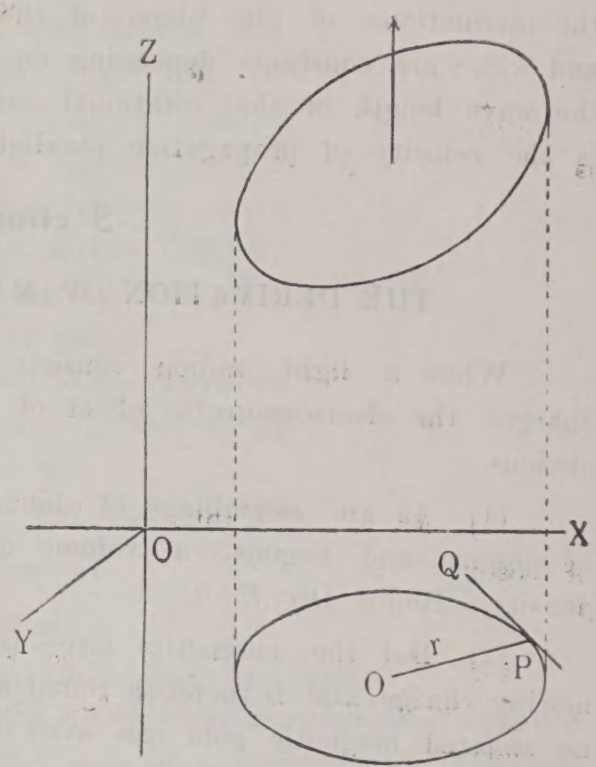
$$\text{These give } \frac{\mu k}{c^2} \frac{\partial^2 \varkappa}{\partial t^2} = \nabla^2 \varkappa \quad \text{and} \quad \frac{\mu k}{c^2} \frac{\partial^2 P}{\partial t^2} = \nabla^2 P$$

Thus in its transverse section, light appears to be an electromagnetic phenomenon in which the electric and magnetic forces are perpendicular to each other, and in the plane at right angles to the line of propagation,

Section V

THE ELECTROMAGNETIC EFFECT.

1. The swift rotations of the positive and negative components of a radion round the common centre of gravity would be like electric currents flowing along the elliptical orbit, but in opposite directions. The magnetic field is nothing but the transverse effect produced by the moving charge. If we take a cylindrical pencil of light, consisting of a large number of binary radions, revolving in all sorts of elliptical orbits, all travelling parallel to the Z-axis, their effect on a cross-section at right angles to the forward path will be the resultant effect of their projections on an XY plane. The projections of the radionic orbits will be ellipses with different inclinations to the two axes



2. We shall first consider the simple case where the two components (the poson and the negon) are revolving round each other in circles. The electric forces between the positive and the negative charges will be only along the rotating diameter joining them, and neither along the tangent to the orbit nor normal to its plane.

For a region free from charges, Maxwell's electromagnetic equations in cylindrical co-ordinates (r, θ, z) with electric and magnetic components $P, Q, R,$ and α, β, γ respectively, where $Q = R = 0$, and from symmetry round the axis $\frac{\partial}{\partial\theta} = 0$, give

$$\left.\begin{aligned} -\frac{\partial\beta}{\partial z} &= \frac{k}{c}\frac{\partial P}{\partial t} \\ \frac{\partial\alpha}{\partial z} - \frac{\partial\gamma}{\partial r} &= 0 \\ \frac{1}{r}\frac{\partial(\beta r)}{\partial r} &= 0 \end{aligned}\right\} \qquad \left.\begin{aligned} 0 &= -\frac{\mu}{c}\frac{\partial\alpha}{\partial t} \\ \frac{\partial P}{\partial z} &= -\frac{\mu}{c}\frac{\partial\beta}{\partial t} \\ 0 &= -\frac{\mu}{c}\frac{\partial\gamma}{\partial t} \end{aligned}\right\}$$

$$\left.\begin{aligned} \frac{1}{r}\frac{\partial}{\partial r}(rP) &= 0 \\ \frac{1}{r}\frac{\partial}{\partial r}(r\alpha) + \frac{\partial\gamma}{\partial z} &= 0 \end{aligned}\right\}$$

(See Weatherburn's Vector Analysis §§. 12 & 125) These yield

$$\frac{k}{c}\frac{\partial^2 P}{\partial t^2} = -\frac{\partial}{\partial t}\frac{\partial\beta}{\partial z} = -\frac{\partial}{\partial z}\frac{\partial\beta}{\partial t} = \frac{c}{\mu}\frac{\partial^2 P}{\partial z^2}$$

$$\therefore \qquad \frac{\partial^2 P}{\partial t^2} = \frac{c^2}{k\mu}\frac{\partial^2 P}{\partial z^2},$$

$$\text{Similarly } \frac{\partial^2\beta}{\partial t^2} = \frac{c^2}{k\mu}\frac{\partial^2 P}{\partial z^2}.$$

This is a wave propagation along the Z-axis with velocity $\frac{c}{\sqrt{k\mu}}$ without any further assumption.

Also $$\frac{\partial\alpha}{\partial t} = \frac{\partial\gamma}{\partial t} = 0.$$

So α and γ are independent of time, and therefore they do not really enter into the wave equation.

And rP and $r\beta$ are independent of r, and owing to the symmetry round the centre, independent of θ also.

Hence $$P = \frac{A}{r} \qquad \text{and} \qquad \beta = \frac{B}{r},$$

where A and B are functions of time only.

Also $\frac{\partial\alpha}{\partial z} = \frac{\partial\gamma}{\partial r}$, a particular solution of which is $\alpha = \gamma = 0$, which is physically quite plausible.

As the positive and negative charges are rotating in the same direction, their righthanded and lefthanded effects would cancel each other on the average, and there will be no net magnetic force along the normal to the plane. When the charges are at opposite ends, $\varkappa$ must necessarily be zero.

3. If the orbit is elliptical then $\frac{\partial}{\partial\theta} \neq 0$.

Accordingly

$$\left.\begin{aligned} \frac{1}{r}\frac{\partial\gamma}{\partial\theta} - \frac{\partial\beta}{\partial z} &= \frac{k}{c}\frac{\partial P}{\partial t} \\ \frac{\partial\varkappa}{\partial z} - \frac{\partial\gamma}{\partial r} &= 0 \\ \frac{1}{r}\frac{\partial(\beta r)}{\partial r} - \frac{1}{r}\frac{\partial\varkappa}{\partial\beta} &= 0 \end{aligned}\right\} \qquad \left.\begin{aligned} 0 &= -\frac{\mu}{c}\frac{\partial\varkappa}{\partial t} \\ \frac{\partial P}{\partial z} &= -\frac{\mu}{c}\frac{\partial\beta}{\partial t} \\ -\frac{1}{r}\frac{\partial P}{\partial\theta} &= -\frac{\mu}{c}\frac{\partial\gamma}{\partial t} \end{aligned}\right\}$$

$$\left.\begin{aligned} \frac{1}{r}\frac{\partial}{\partial r}(rP) &= 0 \\ \frac{1}{r}\frac{\partial}{\partial\theta}(\varkappa r) + \frac{1}{r}\frac{\partial\beta}{\partial\theta} + \frac{\partial\gamma}{\partial z} &= 0 \end{aligned}\right\}$$

Hence $$\frac{k}{c}\frac{\partial^2 P}{\partial t^2} = \frac{\partial}{\partial t}\left\{\frac{1}{r}\frac{\partial\gamma}{\partial\theta} - \frac{\partial\beta}{\partial z}\right\}$$

$$= \frac{c}{\mu}\frac{1}{r^2}\frac{\partial^2 P}{\partial\theta^2} + \frac{c}{\mu}\frac{\partial^2 P}{\partial z^2}$$

which will be a wave equation with velocity $\frac{c}{\sqrt{\mu k}}$ along the Z-axis if

$$\frac{\partial^2 P}{\partial\theta^2} = 0$$

or

$$P = A_1 + B_1\theta$$

where A_1 and B_1 are constants with respect to θ only and may be functions of r and t.

But as $\frac{\partial}{\partial r}(rP) = 0$, it follows that rP is independent of r.

Hence $P = A + B\theta$, where A and B are functions of time only.

4. Corrections for the rotating charged components of the radion will be considered later.

5. (1) As the opposite charges are always at the ends of a diameter, there would naturally be electric force along it, the radial value of which for a whole revolution may be denoted by P.

(2) In spite of the fact that the charges are rotating there must be an electric intensity between them. But there is no reason why there should be any electric force at right angles to the diameter joining them, nor any reason for there being a force at right angles to their plane.

(3) In the case of material particles like a hydrogen atom, the electric force is $\propto e^2/r^2$ and they do not blow off. In the case of light, subject to Maxwell's equations, the force is $\propto e^2/r$, which necessitates the radions travelling forward with the velocity of light.

6. THE SPECTRAL SHIFT.

If V be the forward velocity, T the period of rotation and λ the wavelength, then $\lambda = VT$, which is the axial distance travelled in one revolution.

Hence as the Sun's gravitation cannot change T, but only affects V,

$$\frac{\lambda s}{\lambda e} = \frac{Vs}{Ve}$$

From this relation the results of Ch. XIII Sec. IV follow.

The method adopted in Einstein's Relativity of making a wholly arbitrary and really fallacious assumption that radiating solar atoms are "momentarily at rest" is open to a fatal objection. As every atom must, in addition to its own intrinsic velocity, possesses a high radial velocity, if not also in some cases a transverse velocity as well, the assumption is altogether an impossible one.

7. THE DEFLECTION OF LIGHT.

When light consists of material corpuscles i.e. radions, the bending of light owing to the gravitation of the Sun becomes obvious.

8. THE SUPPOSED EXPANSION OF THE UNIVERSE.

(i) For circular rotations $P=\frac{A}{r}$, where P is a function of time only. If ω be the angular velocity and m the revolving mass, then

$$\frac{A}{r}=mr\omega^2, \quad \text{where } T=\frac{2\pi}{\omega}$$

From the angular momentum's appproximate constancy.

$$mr^2\omega \text{ is constant.}$$

Hence P. T is constant.

(ii) If with lapse of time there is an exchange of some part of the charges between the positive and the negative components, then the force will decrease, and so the period will increase. It is therefore obvious that as time elapses, the periodic time will tend to obey the Proportionality to Linear Distance law. There is accordingly an inherent diminution of frequency with passage of light through space, explaining the supposed expansion of the Universe. For the spuriousness of the recessional velocities of nebulae see also Ch. III pp. 227-9. (Jan. 21, 1935)

If the formation of the swarm is as is shown in the next Section VI, then the increase of period and therefore the loss of frequency with the distance travelled will take place as shown in Ch. II Sec. III, pp. 27-8.

9 The binary system has some similarity to J. J. Thomson's theory of circular lines of electric rings travelling at right angles to their planes.

(Nature, Vol. 137, pp. 232-3. Feb., 8, 1936)

He takes $P=R=0$.

Then Maxwell's equations give

$$\mu\kappa\frac{\partial^2 Q}{\partial t^2}=\frac{\partial^2 Q}{\partial z^2}+\frac{\partial}{\partial r}\left\{\frac{1}{r}\frac{\partial}{\partial r}(rQ)\right\}$$

This equation cannot possibly represent a wave propagation unless

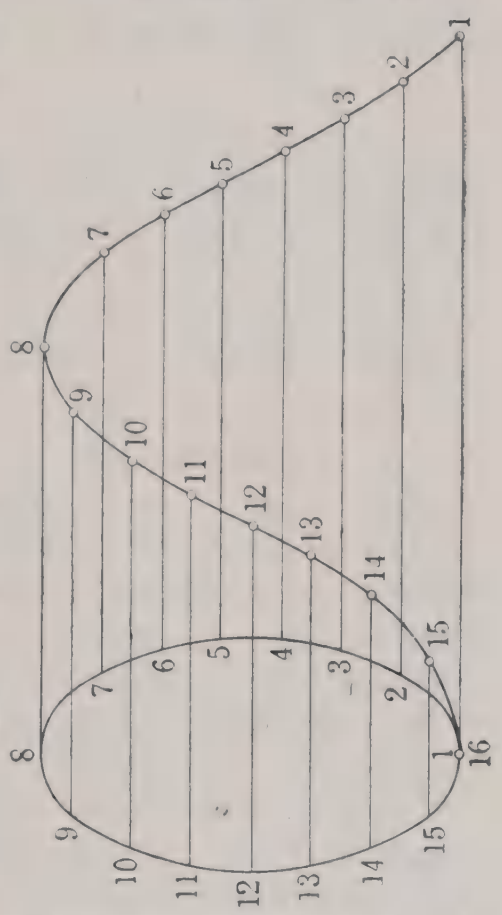
$$\frac{\partial}{\partial r}\left\{\frac{1}{r}\frac{\partial}{\partial r}(rQ)\right\}=0$$

for which the solution is of the form $Q=A\,r+\frac{B}{r}$, which makes Q infinite both at the centre and at ∞. The latter is an impossible result.

Section VI

THE WAVE EFFECT OF A SWARM OF PARTICLES FROM A ROTATING SOURCE

1. Let a radiating source revolve in an elliptical orbit in an anti-clockwise direction occupying the positions, 1, 2, 3, etc. at units of time 1, 2, 3, etc. (may be after many revolutions), and let it emit one radion at each of these positions in the direction of a z-axis at intervals of t. Then at any instant of time, the distance travelled by the first radion will be ct more than that by the second and so on. By marking the positions which they all would attain at this instant it will be seen that although every radion has travelled in a straight path parallel to the Z-axis, the whole group has assumed a spiral formation, like the thread of a screw round the cylindrical pencil. The group will continue to travel forward in this set formation.



The swarm when observed

If a plane be placed at right angles to the axis of the cylinder, the effect of the swarm of radions impinging on this section will be as if there were a shower of rain falling on it, each radion passessing a momentum and causing pressure. The swarm when observed in this way will have a particle aspect.

On the other hand, the effect in the plane section when successive radions reach it will be that of disturbances moving along elliptical orbits, as if produced by a transverse rotatory motion. The effect in this section will be periodic. The swarm when observed in this way will have a wave aspect.

Thus the swarm possesses both the particle and the wave aspects simultaneously, without any contradiction: and either one or the other is

observed according as we observe the effect of the swarm perpendicular to or in the plane section. The picture illustrates the motion of such revolving radions which also will possess both these aspects. In all experiments in which the effect as observed is the result of motion along the path (e.g. scintillation or Compton effect) the swarm will behave like a shower of bullets; whereas in all experiments in which the effect is seen at right angles to the path of light, (e.g. interference or polarisation) the swarm will behave like a wave propagation.

2. *Illustration.* The motion can be clearly illustrated if the nozzle of a rubber tube attached to a water reservoir be made to rotate in an ellipse while water is flowing through it with some force. Although each drop of water, after leaving the nozzle really travels in a straight line. tte stream of water as a whole will appear to travel forward in the form of a helix, the period of rotation of the nozzle and the velocity of the flow of water determining the wave length of the screw motion, $\lambda = V.T.$

3. It is obvious that even if the axis of the cylinder parallel to which the light travels be not at right angles to the plane of the source's orbit, but inclined to it, the axial length of one complete revolution will still represent the longitudinal distance travelled by light during one complete rotational period of the source. Hence the wave length of the swarm of radions from revolving sources is wholly independent of the inclination of the orbit to the path of light and depends on its period only. The inclination of the orbit to the path will merely affect the size of the screw, the dimension diminishing as the inclination increases. A change in the direction of rotation will, however, change a right-handed screw to a left handed one, and vice versa.

4. Such *a* swarm of particles emerging from a rotating source is the exact equivalent of a stream of radions travelling forward in a screw motion.

The wave function can be expressed as

$$\psi = A \sin \frac{2\pi}{\lambda} \left(ct - (lx + my + nz) \right)$$

This can be put more generally as

$$\psi = A\, e^{\frac{2\pi i}{\lambda} \left(ct - (lx + my + nz) \right)}$$

representing a plane wave in the r direction.

This fulfils the differential equation

$$\nabla^2\psi = \frac{1}{c^2}\frac{\partial^2\psi}{\partial t^2}.$$

5. Now experiment with light pressure has established that the heat (which stands for energy) carried by light is equal to its momentum multiplied by its velocity.

Accordingly, $E = \mu c \times c = \mu c^2$, where μ stands for the mass of a radion. This is similar to Einstein's postulate for matter. If r and w be the radius vector and the angular orbital velocity of the whirling radion, then the energy is also

$$E = \tfrac{1}{2}\mu c^2 + \tfrac{1}{2}\mu r\omega^2,$$ as the radion's

potential energy in the orbital motion is zero when its total charge is nil. Accordingly $c = r\omega$.

Hence $$E = \mu c^2 = \mu r^2\omega^2 = (\mu r^2\omega)\omega = \frac{h}{2\pi}\frac{2\pi}{T} = h\nu.$$

6. THE SEPECTRAL SHIFT

(1) In this formation, gravitation will not affect the wavelength, but only the velocity. Hence $\frac{Ts}{Te} = \frac{Vs}{Ve}$. Thus if wavelength is measured inversely as the frequency, the result is the same as before.

(2) If the solar atoms be travelling outwards radially with velocity v, then the correction to be introduced on account of the Doppler Effect as in Chapter IV, p. 236 is $-\frac{v}{c}\cos\varkappa$, where $\varkappa$ is the angle between the radius of the Sun and the line of sight.

The correction due to the angular velocity ω of the Sun is

$$\frac{a\omega}{c}\ Sin(\pm\varkappa)$$

A FORECAST

1. A beam of light consists of a swarm of discrete radions so far apart as to make the interaction of their respective components, (the posons and negons), with one another negligible.

2. The differences between red rays, violet rays, X rays, and γ rays if not also cosmic rays consist solely in their successively quicker rotations i.e. their frequencies.

3. A group of radions so close together that their respective components interact with one another forms matter. Positrons, electrons or neutrons are formed respectively when either one poson or one negon is in excess, or they combine in equal numbers.

4. If the structure of a radion be similar to that of a hydrogen atom, i.e., mass of the negon negligible as compared to that of the poson, then the total angular momentum of a system composed of a number of posons will always be an integral multiple of that of a radion. This would correspond to Bohr's first assumption.

5. In a stable rotational system the average of any function of the coordinates or their differentials for the whole constant period will remain constant. This will give Sommerfeld's quantum conditions.

6. If a radion is lost by a rotating source, then the elements of the instantaneous orbit will be changed, diminishing the major axis and the latus rectum and also the angular momentum, and therefore producing a new orbit, without any jump, thus establishing a continuity and not a discontinuity in nature.

APPENDIX TO CHAPTER XIV

The Unified Theory of Physical Phenomena

In order to explain interference, diffraction and polarisation it is necessary to impart to the particle character of light a transverse periodic motion. This idea was the basic foundation of the Rotational Theory of light which was Part II of the more general "Unified Theory of Physical Phenomena" published by me in 1933 (Empire Press, Allahabad) a brief abstract of which is given below with references to its pages:—

(1) *Screw motion* (pp. 21-3). It is quite reasonable to suppose that a light particle or radion has a structure similar to that of a planet revolving round the sun i.e. a binary system, possessing, in addition to its forward translational motion, a rotational motion as well. The combined rotational motion and the translational motion would give to each component of the radion a screw-wise motion, and make the curve of its path a sort of a helix or spiral. For example, the path described in space by a component of a radion may be along a piece of thread tightly wound round the curved surface of an elliptical cylinder. It will possess both a rotational velocity and a translational velocity.

(2) *Wave motion*—(p. 25).—Its motion seen (1) along the axis, would be simply a forward motion with velocity c. (2) as a projection on a section at right-angles to the axis, would be a transverse elliptical motion resolvable into two simple harmonic motions at right angles to each other, with a common period, though with different amplitudes and phases, and (3) in a plane containing the axis, a wave motion. The amplitude will vary periodically, with a maximum and a minimum, while the latitudinal projection of the path is an ellipse, the longitudinal projection will be in the form of a wave, with crests and troughs.

(3) *Wavelength, Period and Frequency*—(p. 26)—Let c be the forward translational velocity of the radionic system, T the complete period of rotation and λ the distance travelled along the axis with velocity c during a complete revolution. Then $\lambda = c.T$. Thus the wavelength would be the axial distance travelled lengthwise during one complete revolution. The frequency would obviously be the number of revolutions round the axis per second.

(4) *Conservation of Momentum*—(p. 23)—As its linear momentum must be constant, its forward velocity will remain constant. And as its angular momentum must be constant, the period of rotation must remain constant and the rate of describing the sectional area must be constant

i.e. $m.r.\frac{rd\theta}{dt} = \text{constant} = mh = m.\frac{2\pi ab}{T}$, where a and b are the semi-axes and T is the period of revolution.

(5) *Constant Periodic Time*—(p. 24)—It is the permanence of the periodic time, which characterises light. Monochromatic light is a swarm of radions, possessing the same period, hence having the same wavelength and frequency. (Light emitted from atoms rotating with same period will possess the same period).

(6) *Intensity*—(p. 24).—The intensity of light merely depends on the number of light radions moving along the path of the beam per unit area per unit of time.

The intensity of a pencil of light particles depends on the rate at which energy travels normally across a unit area per unit time i.e $\propto$ velocity and square of amplitude.

(7) *Filling of Space*—(p. 36) As every source of light that we see has a finite size, and radions emerge from all points in it, the emissions from all points cross each other, resulting in a sort of mesh work. Accordingly even though the distance may increase, there are no finite interspaces completely free from radions, and, therefore, the source is visible from all angles.

(8) *Spectrum Colour*—(pp. 28-9)—Difference in colour is due to the difference in the rotational period of the radions. The violet rays spin faster round the axis of the path, have shorter periods of revolution, and therefore shorter wavelengths; but as they perform greater revolutions per unit time, they have higher frequency than

red rays. The latter have a longer period and so take a longer time to complete a revolution and their rotational speed is slower, their wavelength, the longitudinal distance travelled during a revolution, is longer, but the revolutions per unit time being fewer, their frequency is lower. Thus light rays from the ultra violet to the infra red range in the spectrum are arranged merely in their descending order of rotational speed, i,e. the number of revolutions per unit time that they make round the axis of the path, in other words in the order of their decreasing frequency and therefore ascending wavelengths and period.

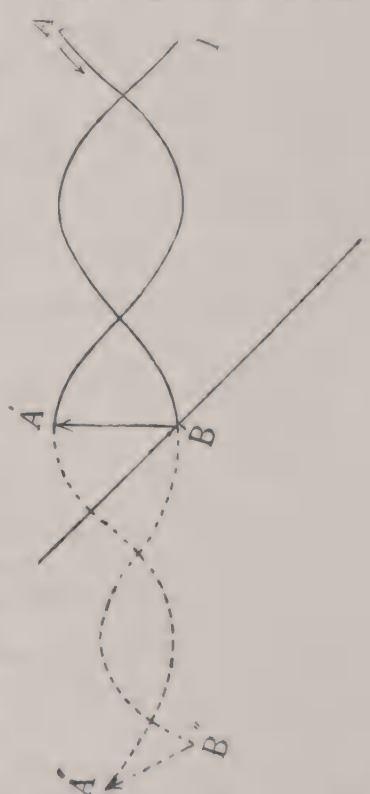
All radions have one constant forward velocity. "The radions which during the time of travelling round the cylindrical path owing to their slow rotational motion cover a longer distance forward in one revolution as the forward velocity is the same have correspondingly longer wavelengths—these are infra-red. Those which in one revolution cover a shorter distance have shorter wavelengths. These are ultra violet. The latter have quicker rotational motion than the former."

(9) *Reflection*—(p. 33)—On a particle theory, reflection of light as a result of collision with atoms admits of a simple explanation. If the medium remains unchanged, the longitudinal velocities remain unaltered and so the different rotational velocities of light of various frequencies do not produce any divergence of the rays, and accordingly no spectrum is seen.

(10) *Cavity Radiation*—(pp. 35-6)—The radions inside a cavity will be reflected and re-reflected over and over again, finding it difficult to emerge. The cavity thus behaves like a black surface, absorbing the radions and not reflecting them. If they do ultimately emerge, their speed of rotation would by then have been diminished considerably by the collisions. They will accordingly get reddened.

(11) *Refraction*—(pp 30-1)—The greater bending of light in a denser medium broke down Newton's corpuscular theory. But this phenomena is explicable on a rotational theory.

First consider a small image shown by a small arrow travelling forward and meeting an inclined surface of a dense medium. The base enters first and its velocity is immediately reduced. The top travels with the former velocity and then enters, after which the entire image travels with reduced velocity. The necessary result of the lower portion getting its velocity reduced earlier than the upper portion is to turn the image round, so that the axis perpendicular to the image is bent towards the normal to the separating surface.

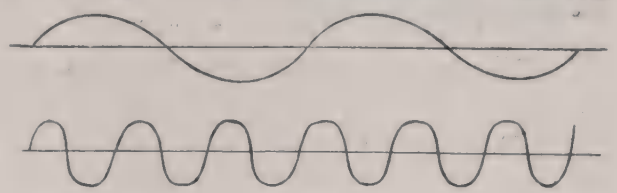


Next consider the two components of a radion revolving in an orbit (i.e. two almost massless particles revolving like binary stars). A complete revolution is performed during the time when the distance of a wavelength is covered in the forward velocity. It follows that during this period one component of the radion would still remain outside the separating surface while the other has gone inside the medium. The forward velocity of the latter is reduced inside the thicker medium, but not that of the one outside. The necessary result is that the plane of rotation is bent, and the axis inclined towards the normal to the surface. The direction of forward motion perpendicular to the transverse vibration is therefore inclined towards the normal. The mutual attraction of the two binaries causes a bending of the path of their propagation

(12) *Refractive Index*—Not only Newton's corpuscular theory failed to explain refraction because he wrongly assumed the horizontal velocity to remain constant, but

even the wave theory also, without another dispersive theory, failed to explain why violet rays with shorter wavelength should bend more than red rays. But on the rotational theory, there being a greater tangential velocity for higher frequency rays, the resistance of the medium reduces the velocity more than in the case of rays not moving so fast. As shorter wavelengths revolve a much greater number of times while a unit length is travelled they meet with greater resistance owing to the collision with the atoms of the medium, than if fewer revolutions occur during that interval. Hence rays of shorter wavelength are refracted more than those of longer wavelength.

(13) *Scattering*—(p. 33)—The same consideration explains a greater scattering for violet rays than for red. Rays which rotate faster during a unit time are bound to have more elliptical orbits per unit distance and must therefore collide against atoms much more than rays with fewer revolutions would do per unit time. This explains Rayleigh's scattering and the blue of the sky.



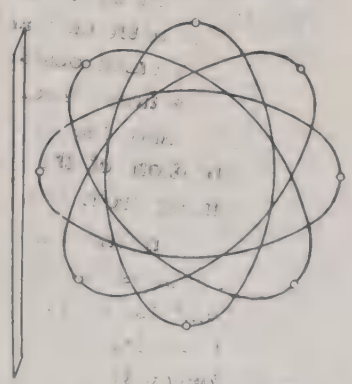
(14) *Penetration*—(p.32)—The classical theories offer no explanation why X-rays, γ-rays and cosmic rays should penetrate more than waves of lower frequency. On the rotational theory it is obvious that a fast rotating screw will pierce further than a slow rotating one. Although the intensity will diminish owing to greater scattering, they will on account of their rapid and inclined motion bore through deeper.

(15) *Pressure*—(p. 36)—The pressure exerted by moving radions by their infringing on a material body is patent.

(16) *Absorption*—(p. 38)—It is clear from the principle of resonance that radions would be taken up by an electron of an atom if their periods of revolution are the same. They would not be retained if there is a difference. It follows that elements would absorb the same kind of radions as they would themselves emit when incandescent, because the period of revolution is identical.

(17) *Compton Effect*—(p. 60)—The particle nature of the light radions has been demonstrated by Compton's discovery that photons in their collisions with electrons obey the laws of conservation of energy and momentum, are deflected like billiard balls and are scattered exactly as if they were a swarm of material particles.

(18) *Polarisation*—(p. 37)—The corpuscular theory based on straight motions of corpuscles broke down when polarisation was discovered which required a transverse vibration. On the rotational theory radions possess transverse motions as well.



(a) It is easily intelligible how radions moving in elliptical orbits will be intercepted by a tourmaline crystal except those which have elongated orbits with their major axes parallel to the axis of the crystal. These latter will be completely obstructed by a second crystal if its axis be at right angles to their major axes.

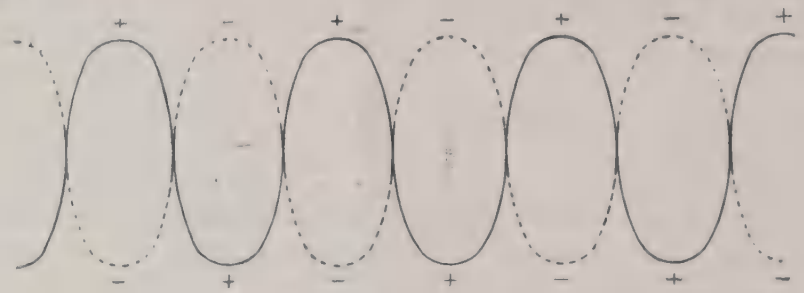
(b) When light radions are pictured as moving in elliptical orbits inclined to the path, those whose orbits are in the plane of the incident and reflected rays will find it easier to pierce through, and indeed for a certain angle of incidence could be completely transmitted

without any being reflected, and be polarised. But those whose orbits are perpendicular to that plane will have greater facility for being reflected than refracted. Hence the reflected light will be completely polarised for a certain angle of incidence.

(c) Double refraction is obviously explicable if in an Iceland spar (calcite) the velocity of the refracted ray is different in different directions giving rise to two different refracted rays polarised in perpendicular planes.

(19) *Interference*—(pp. 33-4)—The rotational theory combines the effect of both the corpuscular and wave theories. Light possesses double motion—the longitudinal motion like a particle causing pressure and scintillation, and the transverse periodic angular motion. The period of rotation being constant, a harmonic motion results. If two parts of a beam meet again after having travelled different distances, a difference in the phase of rotation comes in, which causes interference.

The transverse elliptic motion can be easily resolved into two transverse simple harmonic motions at right angles to each other, with the same period, but different amplitudes and phases.



The reason why light from two different slits can not interfere is that every source of light has fiinite dimensious and light rays from every part of its visible surface come to the slits and get commingled

(20) *Diffraction*—(pp. 34-5)—Undoubtedly atoms and electrons are discreet units and yet they are now found to be diffracted. It is therefore quite wrong to suppose that it is impossible for particles to be diffracted. All that is necessary is that particles must have a periodic transverse motion, which is obtained in the Rotational Theory. The radions about to emerge from the pinhole owing to their rotatinal motious collide against the electrons in the atoms at the extremity and are therefore deflected in various directions. The fac that a small obstacle can stop the visibility of a source of light confirms the particle theory. The absence of the exact shadow of a needle or at wire and the presence of blurred edges are the result of the transverse vibration of the radions. Those passing by the two sides behave like light coming from two sources, causing interference.

On the wave theory, it has always been supposed that the effect on the sides away from the main path of light is destroyed. But if each point is a new source of secondary wavelets, then new sources should be taken far away from the hole, and waves must move both backwards and forwards. Hence light ought to bend back and illuminate all space as sound fills all space. The bending should not depend on wavelength only. This difficulty does not arise in the Rotational theory.

(21) *Ionisation*—A rotating radion can produce ionisation by knocking out an electron from an atom. Obviously if a radion is moving with a faster angular velocity, its success in knocking out an electron would be greater than if it be revolving more slowly. Also a faster rotating radion will describe

more revolutions per unit time or per unit distance, and so its chances of hitting electrons would be greater. Hence waves of shorter wavelength, produce greater ionisation than those of longer.

(22) *The Quantum of Light*—(pp. 37-8)—On the particle theory, the existence of photons as separate discreet units is obvious. A definite quantity of energy is associated with each rotating radion, the angular momentum of each rotating radion is Planck's constant h. It follows that additions of energy to an atom imparted by light can be in multiples of $h\nu$ only.

(23) *Zeeman Effect*—(p. 59)—A magnetic field makes the elliptical orbits of atoms become parallel to one another and at right angles to the line of force. If light radions are emitted by the rotating electrons then when seen along the lines of force through cylindrical holes in the poles of the magnet, the projections of the ellipses would be circles and light would be circularly polarised; and the direction of polarisation would be opposite if seen from the North and South Poles. But when seen at right angles to the lines of force, the projections of the circles would be straight lines, and the light will appear to be plane polarised.

(24) *Stark Effect*—(p. 60)—produced by an electrical field is similarly explained.

(25) *The Cosmic rays*—(pp. 61-2)—Light rays, Xrays and Cosmic rays all may emanate from atomic systems, the difference between them consisting in the sizes of the radii of the orbits from which they emerge. The greater penetrating power is due to the greater rotatory motion and their linear momentum, all being material particles.

(26) *The Expanding Universe*—(pp. 60-61)—The rotating light radions can explain the decrease in the angular motion due to collisions with particles of matter, and also due to the pull of heavenly bodies causing an enlargement of the orbits, as light radions pass through space. The reddening of light is accordingly proportional to the distance travelled through space.

NOTE.--A short abstract of the Rotational Theory of Light was also given in the author's Presidential Address to the Academy of Sciences, on January 20 1934. (Pr. Ac. Sc., III, pp. 358-9).

A REQUEST

Since 1933 over a dozen reprints have been sent out from time to time to countries all over the world. For instance, in addition to the usual number of copies, 1500 extra copies of the Law of Gravitation were printed by the Baptist Mission Press. Similarly 2000 extra copies of Chapter XIII on Gravitation were printed by the Globe Press. Out of these over 2500 copies were sent out by free post to Universities, Observatories and scientists, whose addresses were known; some copies were sent even under registered covers to eminent relativists, scientists, and mathematicians. But with the exception of a limited number, who kindly acknowledged receipt, it is not even known whether the copies reached the addressees. Of course the majority would not be interested in this special subject, and there may be many who would not like to be bothered by such reprints. Accordingly only 1000 extra copies of Chapter XIV have been printed and are being distributed.

The next paper will be submitted to the Academy after the coming Summer Vacation, and, if accepted, is likely to be printed in the later half of 1937. Of this only 500 reprints, or fewer according to requirements, will be printed, in addition to the number required by the Academy, and will be submitted only to those scientists who would care to have a copy and would, therefore, kindly send an intimation in advance.

S. M. Sulaiman

Erratum

In Ch. XIII, p. 286, Equation (40. 31)

please read $+m$ for $-m$

and $d-b$ for $d-a$

Globe Press, Allahabad